



SURFACE VEHICLE STANDARD

J2265™

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Superseded by ISO 12156-1 and -2

Diesel Engines - Diesel Fuel – Performance
Requirement and Test Method for Assessing Fuel Lubricity

RATIONALE

SAE J2265 has been cancelled because the content of this standard is fully covered by ISO 12156-1 and -2. Therefore, to eliminate such redundancy and confusion in coordinating the standards between ISO and SAE, this document is declared cancelled and superseded by ISO 12156-1 and -2.

CANCELLATION NOTICE

This Technical Report has been declared "CANCELLED" as of September 2015 and has been superseded by ISO 12156-1 and -2. By the action, this document will remain listed in the respective index, if applicable. Cancelled Technical Reports are available from SAE.

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This SAE document is similar to ISO CD12156/1 and CD12156/2.

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board format.

All diesel fuel injection equipment has some reliance on diesel fuel as a lubricant. Wear due to excessive friction resulting in shortened life of engine components, such as diesel fuel injection pumps and injectors, has sometimes been ascribed to lack of lubricity in the fuel.

The relationship of test results to diesel injection system component distress due to wear has been demonstrated for some fuel/hardware combinations where boundary lubrication is a factor in the operation of the component.

Test results from fuels tested to this procedure have been found to correlate to some fuel/hardware combinations and provide an adequate predication of the lubricating quality of the fuel.

This SAE document is similar to ISO CD12156/1 and CD12156/2.

1. **Scope**—This SAE Standard specifies: a test method for assessing the lubricating property of diesel fuels including those which may contain a lubricity enhancing additive, and the performance criteria necessary to ensure reliable operation of diesel fuel injection equipment with respect to fuel lubrication of such equipment.

It applies to fuel used in diesel engines.

2. References

- 2.1 **Applicable Publications**—The following publications contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated.

- 2.1.1 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 329—Specification for Acetone

ASTM D 362—Specification for Industrial Grade Toluene

ASTM D 4306—Practice for Sampling Aviation Fuel for Tests Affected by Trace Contamination

ASTM E 18—Standard Test Method for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E 98—Standard Test Method for Vickers Hardness of Metallic Materials

2.1.2 AISI PUBLICATION—Available from AISI, 1000 16th Street, NW, Washington, DC 20036.

AISI E-52100—Chromium Alloy Steel

2.1.3 ANSI PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI B3.12—Metal Balls

2.1.4 ISO PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 4259—Petroleum products—Determination and application of precision data in relation to methods of test

3. Definitions

3.1 Lubricity—A property of the fluid, measured by the wear scar, in millimeters, produced on an oscillating ball from contact with a stationary plate immersed in the fluid operating under closely controlled conditions.

4. Performance Requirement

4.1 The performance requirement for diesel fuel in compliance with this document shall be a Wear Scar Diameter (WSD) not greater than 0.45 mm at a test temperature of 60 °C. (In the event fuels with a flash point below 60 °C are to be tested, an alternative test temperature of 25 °C may be used. The maximum WSD under this condition is 0.38 mm.)

4.2 There may be additive/fuel combinations with a greater WSD than specified previously which may give acceptable performance as agreed between fuel supplier and purchaser.

5. Summary of Test Method

5.1 The fluid under test is placed in a test reservoir in which the fluid temperature is maintained to the specified option. A fixed steel ball is held in a vertically mounted chuck and forced against a horizontally mounted stationary steel plate with an applied load. The test ball is oscillated at a fixed frequency and stroke length while contact with the plate is fully immersed in the fluid reservoir. The metallurgies of the ball and plate, temperature, load, frequency, and stroke length are specified. The wear scar generated on the test ball is a measure of the fluid lubricating properties.

6. Apparatus

6.1 Test Apparatus¹—Capable of engaging a steel ball loaded against a stationary steel plate with an applied load and oscillating at a fixed frequency and stroke length while the contact interface is fully immersed in a fluid reservoir according to the test conditions as follows:

- a. Fluid Volume—2 mL $\pm$ 0.20 mL
- b. Stroke Length—1 mm $\pm$ 0.02 mm
- c. Frequency—50 Hz $\pm$ 1 Hz
- d. Fluid Temperature—25 °C $\pm$ 2 °C or 60 °C $\pm$ 2 °C

1. HFRR units, HFR2, made by PCS Instruments, The Technology Transfer Centre, Sherfield Building, Imperial College London, SW7 2AZ have been found satisfactory.

- e. Relative Humidity—>30%
- f. Applied Load—200 g
- g. Test Duration—75 min $\pm$ 0.1 min
- h. Bath Surface Area—6 cm² $\pm$ 1 cm²

6.2 Specimen Bath—Capable of holding a specimen plate in a rigid manner and which will also contain the test fuel. The temperature of this bath, and consequently the test fuel contained in it, should be achieved by means of an electrically controlled heater pad to which the specimen bath can be closely attached.

6.3 Control Unit—For controlling variable parameters with an electronic data acquisition and control system.

6.4 Microscope—Capable of 100X magnification in graduations of 0.1 mm and incremented in divisions of 0.01 mm.

6.4.1 Glass Slide Micrometer, with a scale ruled in 0.01 mm divisions.¹

6.5 Cleaning Bath—Ultrasonic seamless stainless steel tank with adequate capacity and a cleaning power of 40 W or greater.

7. Reagents and Materials

7.1 Test Plate—of AISI E-52100 steel machined from annealed rod, having a Vickers hardness "HV 30" scale number of 190 to 210, turned, lapped, and polished to a surface finish of less than 0.02 μ m R_a.

7.2 Test Ball—(Grade 24 per ANSI B3.12) of AISI E-52100 steel, with a diameter of 6.00 mm, having a Rockwell hardness "C" scale (HRC) number of 58 to 66, and a surface finish of less than 0.05 μ m R_a.

7.3 Desiccator—Containing a nonindicating drying agent, capable of storing test plates, balls, and hardware.

7.4 Gloves—Clean, lint-free, cotton, disposable.

7.5 Wiper—Wiping tissue, light-duty, lint-free, hydrocarbon-free, disposable.

7.6 Toluene—(Warning—See Note 1), conforming to Specification ASTM D 362.

NOTE—**Warning**—Flammable. Harmful if inhaled. See Appendix A.1.

7.7 Acetone—(Warning—See Note 2), conforming to ASTM D 329.

NOTE—**Warning**—Extremely flammable. Vapors may cause flash fire. See Appendix A.2.

7.8 Reference Fluid—(Warning—See Note 3), shall be a narrow-cut isoparaffinic solvent.²

NOTE—**Warning**—Flammable. Vapor harmful. See Appendix A.3.

8. Preparation of Apparatus

8.1 Cleaning of Apparatus and Test Components

8.1.1 TEST PLATES, AS RECEIVED

1. Catalog No. 31-16-99 from Bausch and Lomb, Inc., has been found satisfactory. A certificate of traceability from the National Institute of Standards and Technology is available.

2. Solvent is ISOPAR M, manufactured by the Exxon Company, USA, P.O. Box 2180 Houston, TX 77001.

- 8.1.1.1 The test plates shall be partially stripped of any wax-like protective coatings by manually rubbing them with rags or paper towels saturated with toluene.
- 8.1.1.2 Place partially cleaned plates in a clean beaker. Transfer a sufficient volume of toluene in the beaker such that the test plates are completely covered and critical surfaces are in contact with sufficient solvent.
- 8.1.1.3 Place beaker in ultrasonic cleaner and turn on for 7 min.
- 8.1.1.4 Handle all clean test pieces with clean forceps or disposable gloves. Remove the test plates and repeat the previous procedure with acetone for 2 min.
- 8.1.1.5 Dry and store in desiccator.
- 8.1.2 **TEST BALLS, AS RECEIVED**—The test balls are to be cleaned following the same procedure as for the test plates.
- 8.1.3 **HARDWARE**—The hardware, fixtures, fittings, and utensils, that is, all items that come into contact with the test plates, test balls, or test fuel, shall be cleaned by washing thoroughly with toluene, dried, and rinsed with acetone. Dry and store in a desiccator.

9. Calibration and Correction

- 9.1 **Temperature**—The temperature control of the lower specimen bath should be checked using a calibrated temperature measuring device.
- 9.2 **Stroke Length**—The stroke length should be checked by measuring the wear scar on the lower specimen, using a calibrated microscope, after running a test on the reference fluid. The width of the wear scar should be subtracted from the length of the wear scar to give the actual stroke length.
- 9.3 **Run Time**—The run time should be checked with a calibrated stopwatch.
- 9.4 **Test Rig**—The test rig shall be calibrated by testing the reference fluid in accordance with Section 10. Perform two tests at the test temperature to which the test rig is being calibrated. Further tests or corrective action to calibrate the test rig will be required if the WSDs differ more than 0.08 mm from each other or from the average WSD for the reference fluid which at 25 °C is 0.58 mm and at 60 °C is 0.62 mm.

10. Procedure

- 10.1 The summary of test conditions is included in 6.1.
- 10.2 The greatest care shall be taken to adhere strictly to cleanliness requirements and to the specified cleaning procedures. During handling and installation procedures, protect cleaned test parts (plates, balls, reservoir, and fixtures) from contamination by using clean forceps and wearing clean cotton gloves.
- 10.3 Using forceps, place the lower specimen (test plate) into the specimen bath, shiny side up. Secure the test plate to the bath and the bath to the test rig. Ensure the thermocouple is properly placed in the reservoir.
- 10.4 Using forceps, place the test ball into the holder and attach the holder to the end of the vibrator arm. Ensure the holder is horizontal before fully securing the unit.
- 10.5 Using a pipette, place 1 mL of the test fuel into the bath.
- 10.6 Set the temperature controller to the desired test temperature and switch on the heater. Set the stroke length. Set the vibration frequency.

- 10.7** When the temperature has stabilized, lower the vibrator arm and suspend a 200 g weight from the arm. Start the vibrator unit.
- 10.8** Operate the test for 75 min. At the completion of the test, switch off the vibrator unit and the heater. Lift up the vibrator arm and remove the upper specimen holder.
- 10.9** Rinse the upper specimen (still in the holder) in cleaning solvents and dry with a tissue. Using a permanent marker, circle the wear scar on the ball.
- 10.10** Remove the lower specimen bath, properly dispose of the fuel. Remove the disc and wipe it clean. Place the disc in a storage receptacle (plastic bag) marked with the unique test reference.
- 10.11** Place the upper specimen holder under the microscope and measure the wear scar diameter per Section 11.
- 10.12** Upon completion of the wear scar measurement, remove the upper specimen from the holder and place the ball together in storage with the lower specimen.

11. Measure of the Wear Scar

- 11.1** Turn on microscope light and position test ball under microscope at 100X magnification.
- 11.2** Focus microscope and adjust stage such that wear scar is centered within the field of view.
- 11.3** Align the wear scar to a divisional point of reference on the numerical scale with the mechanical stage controls. Measure the major axis to the nearest 0.01 mm. Record the readings on the data sheet.
- 11.4** Align the wear scar to a divisional point of reference on the numerical scale with the mechanical stage controls. Measure the minor axis to the nearest 0.01 mm. Record the readings on the data sheet.
- 11.5** Record condition of wear area if different from the reference standard test, that is, debris color, unusual particles or wear pattern, visible galling, etc., and presence of particles in the reservoir.

12. Calculation

- 12.1** Calculate the wear scar diameter as follows in Equation 1:

$$\text{WSD} = (M + N)/2 \quad (\text{Eq. 1})$$

where:

WSD = Wear scar diameter, mm
M = Major axis, mm
N = Minor axis, mm

13. Report

- 13.1** Report the following information:

- 13.1.1 Major axis, minor axis, and wear scar diameter to the nearest 0.01 mm
- 13.1.2 Description of the wear scar area
- 13.1.3 Fuel temperature